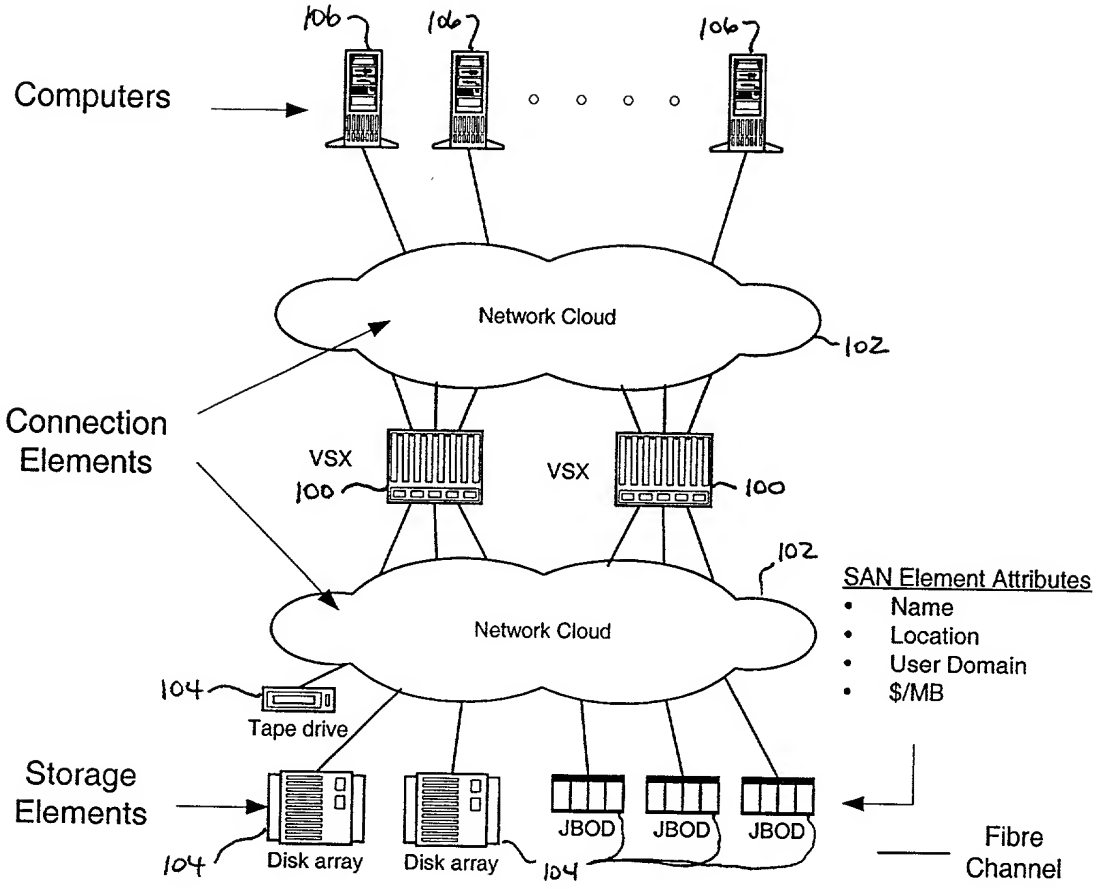

Computers
106
106
106
Network Cloud
102
Connection Elements
VSX
100
VSX
100
102
Network Cloud
SAN Element Attributes
• Name
• Location
• User Domain
• $/MB
104
Tape drive
Storage Elements
104
Disk array
Disk array
JBOD
JBOD
JBOD
104
Fibre Channel

FIG. 1

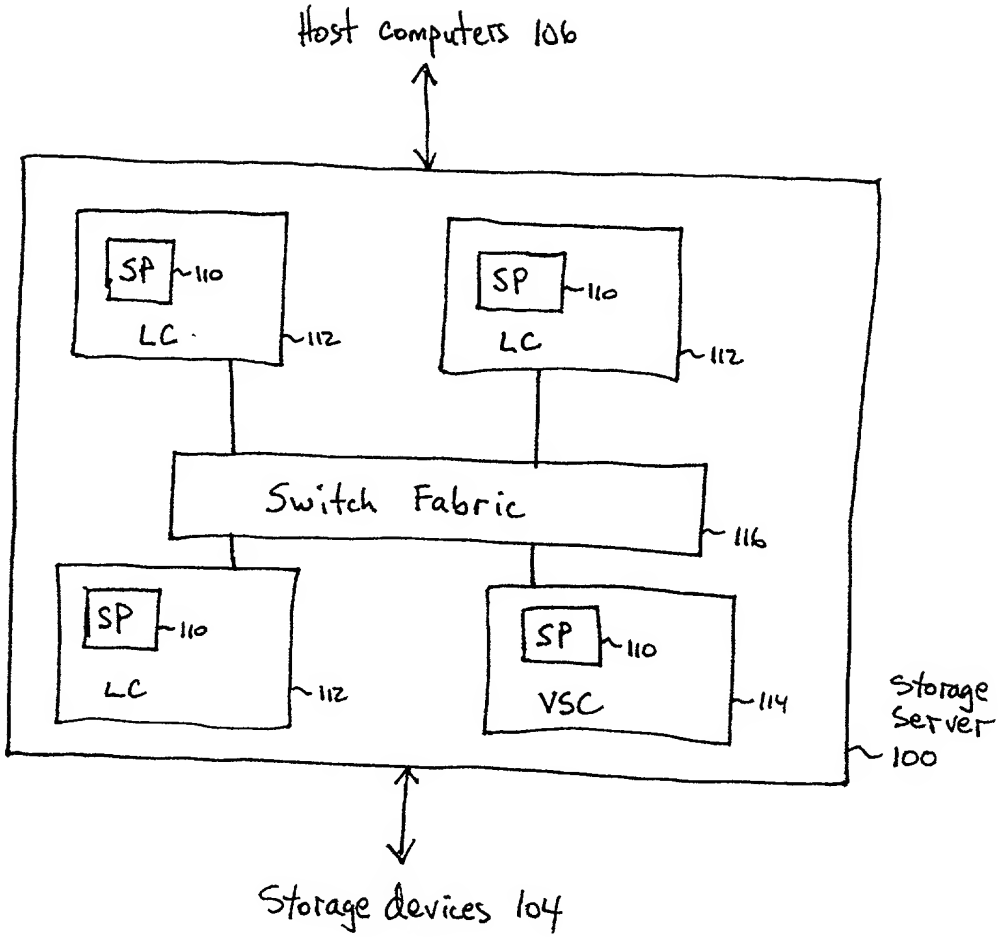

Host computers 106
SP
110
LC
112
SP
110
LC
112
Switch Fabric
116
SP
110
LC
112
SP
110
VSC
114
Storage Server
100
Storage devices 104

FIG. 2A

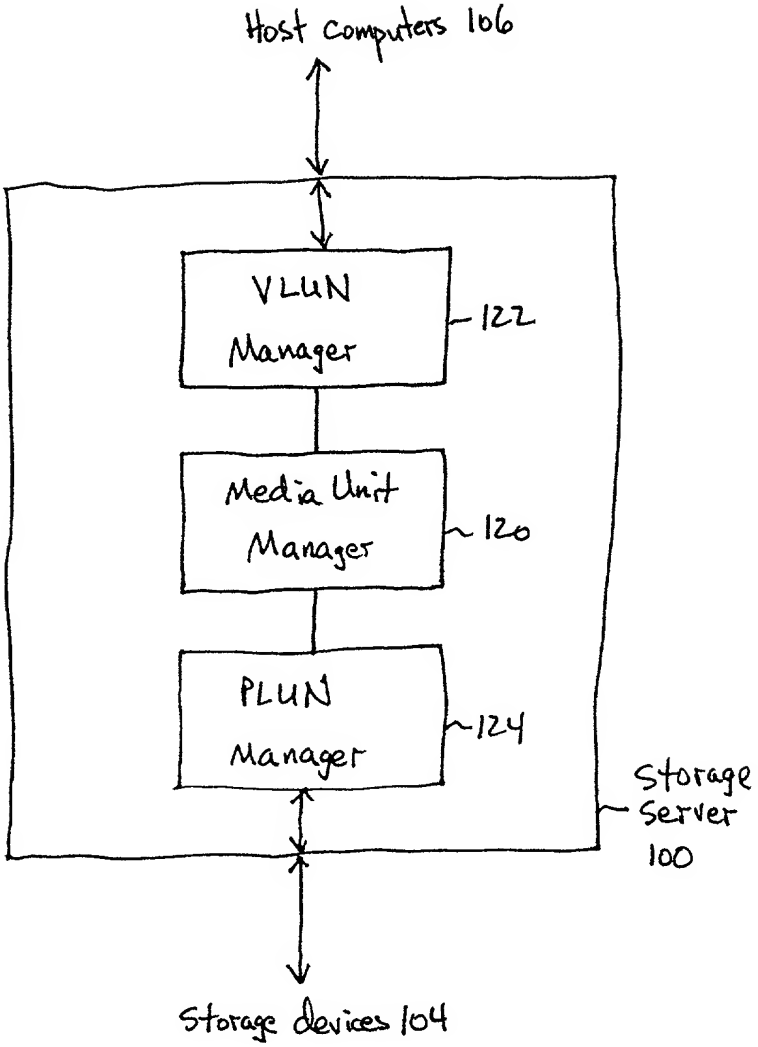

Host computers 106
VLUN Manager
122
Media Unit Manager
120
PLUN Manager
124
Storage Server 100
Storage devices 104

FIG. 2B

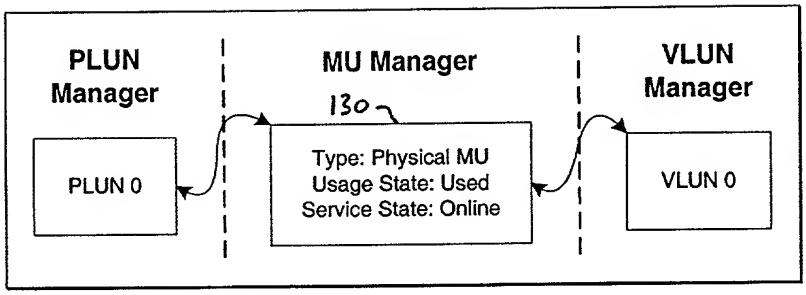

PLUN Manager
MU Manager
130
VLUN Manager
PLUN 0
Type: Physical MU
Usage State: Used
Service State: Online
VLUN 0

FIG. 3

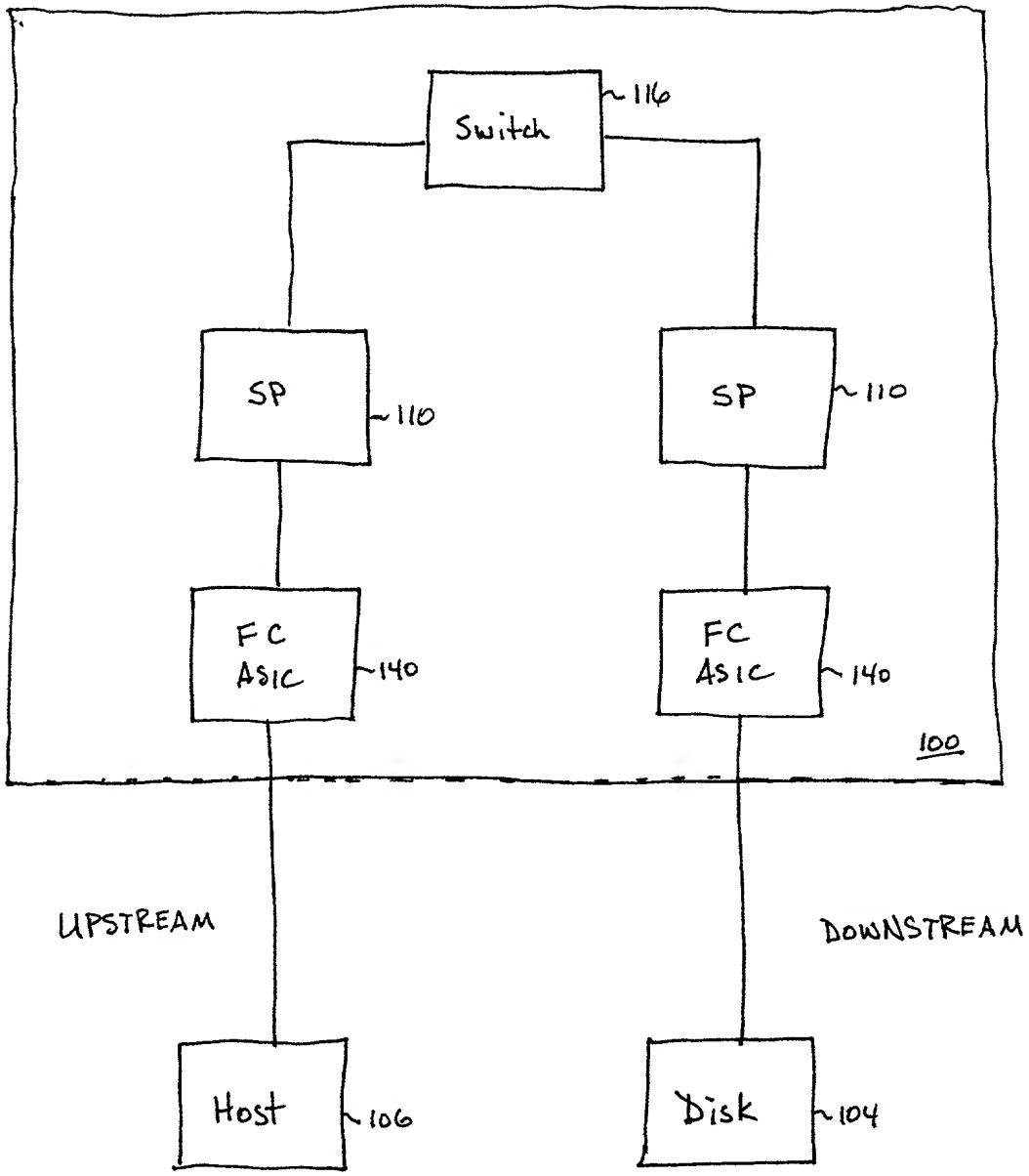

Switch
116
SP
110
SP
110
FC
ASIC
140
FC
ASIC
140
100
UPSTREAM
DOWNSTREAM
Host
106
Disk
104

FIG.4

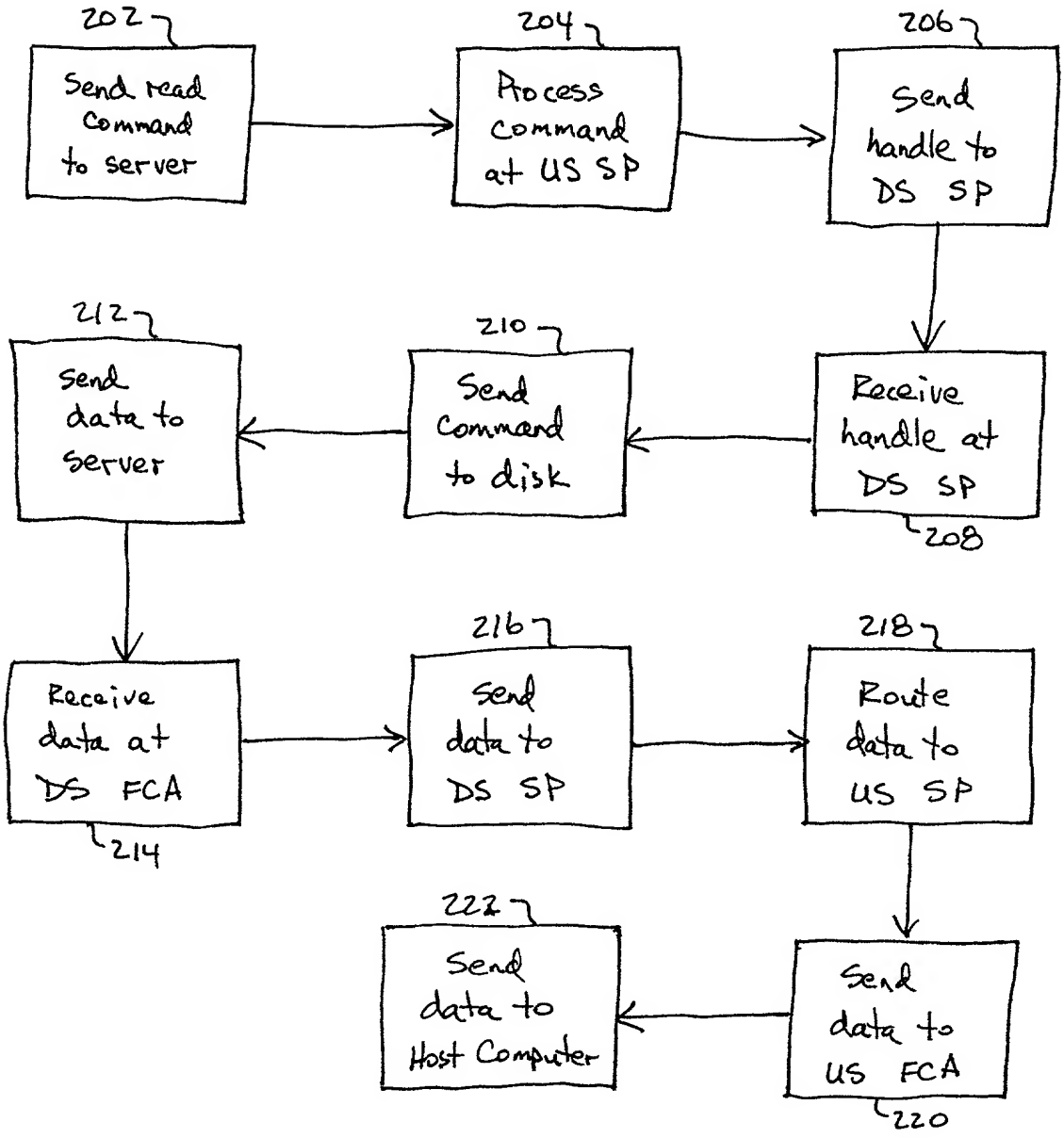

202
Send read command to server
204
Process command at US SP
206
Send handle to DS SP
208
Receive handle at DS SP
210
Send command to disk
212
Send data to server
214
Receive data at DS FCA
216
Send data to DS SP
218
Route data to US SP
220
Send data to US FCA
222
Send data to Host Computer

FIG. 5

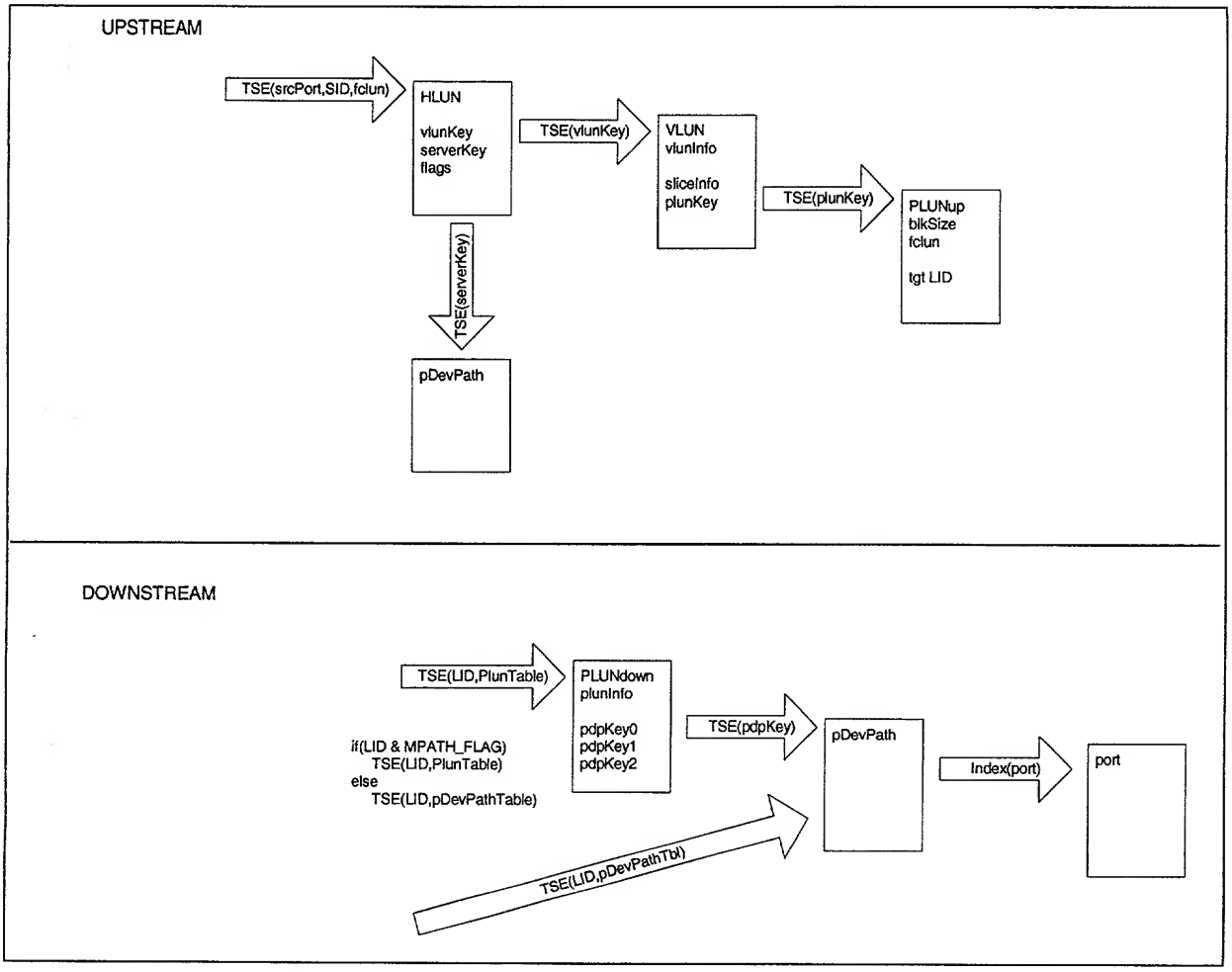
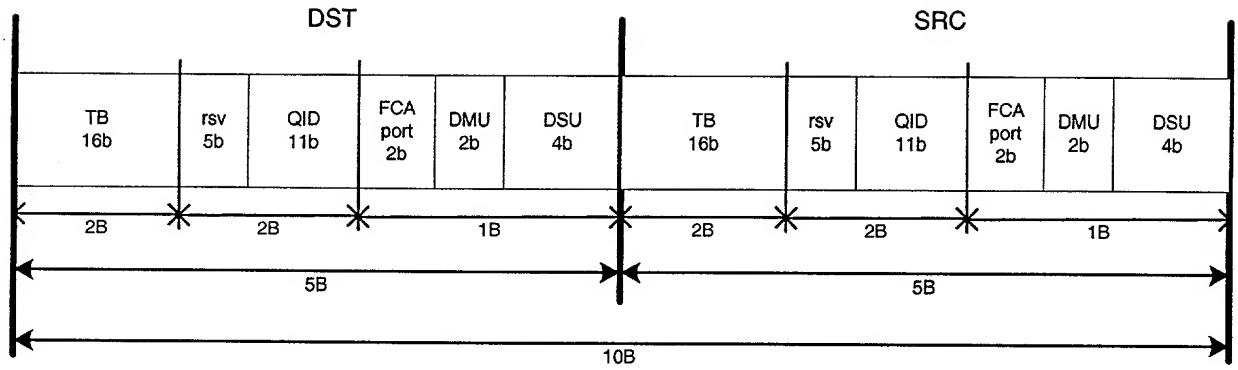

UPSTREAM
TSE(srcPort,SID,fclun)
HLUN
vlunKey
serverKey
flags
TSE(vlunKey)
VLUN
vlunInfo
sliceInfo
plunKey
TSE(plunKey)
PLUNup
blkSize
fclun
tgt LID
TSE(serverKey)
pDevPath
DOWNSTREAM
TSE(LID,PlunTable)
PLUNdown
plunInfo
pdpKey0
pdpKey1
pdpKey2
if(LID & MPATH_FLAG)
TSE(LID,PlunTable)
else
TSE(LID,pDevPathTable)
TSE(pdpKey)
pDevPath
Index(port)
port
TSE(LID,pDevPathTbl)

FIG. 6


DST
SRC
TB
16b
rsv
5b
QID
11b
FCA
port
2b
DMU
2b
DSU
4b
TB
16b
rsv
5b
QID
11b
FCA
port
2b
DMU
2b
DSU
4b
2B
2B
1B
2B
2B
1B
5B
5B
10B

310

FIG. 7

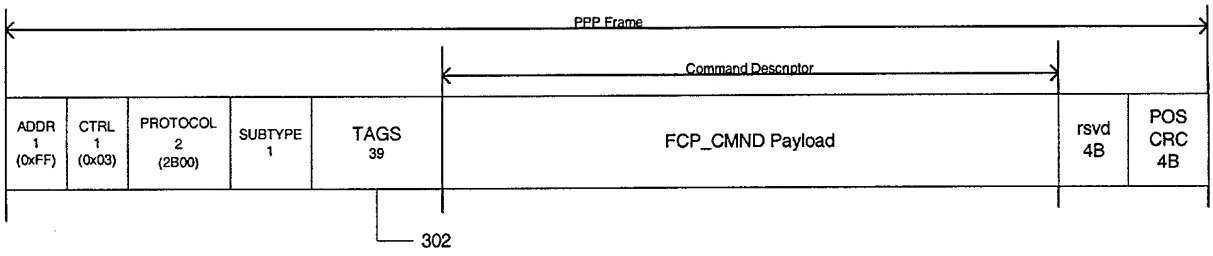

PPP Frame
Command Descriptor
ADDR 1 (0xFF)
CTRL 1 (0x03)
PROTOCOL 2 (2B00)
SUBTYPE 1
TAGS 39
FCP_CMND Payload
rsvd 4B
POS CRC 4B
302
300

FIG. 8

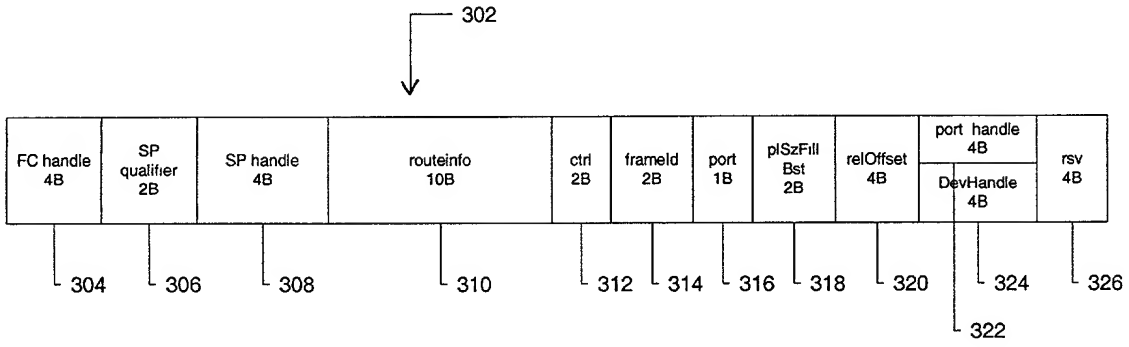
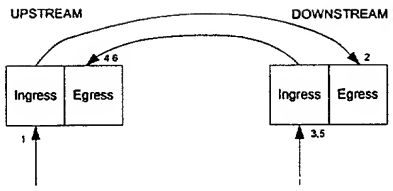
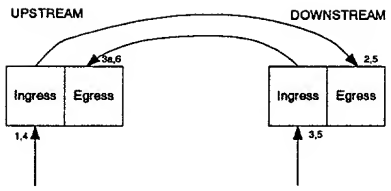

302
FC handle 4B
SP qualifier 2B
SP handle 4B
routeinfo 10B
ctrl 2B
frameId 2B
port 1B
plSzFill Bst 2B
relOffset 4B
port handle 4B
DevHandle 4B
rsv 4B
304
306
308
310
312
314
316
318
320
322
324
326

FIG. 9



UPSTREAM INGRESS COMMAND (1)	DOWNSTREAM EGRESS COMMAND (2)	DOWNSTREAM INGRESS DATA (3)	UPSTREAM EGRESS DATA (4)	DOWNSTREAM INGRESS STATUS (5)	UPSTREAM EGRESS STATUS(6)
FCP 1. Allocate IoCB 2. Copy IoCB header to scratch1 3. Extract ownId,peerId into IoCB	FCP 1 Allocate IoCB 2 Save srcBlade from FCB 3 Respond with IoCB handle back to upstream	FCP 1 Look up IoCB	FCP 1 Look up IoCB	FCP 1 Look up IoCB 2 Ship to upstream status 3 Deallocate IoCB	FCP 1 Look up IoCB
SM 1. Look for hLun(SID,FCLUN,port) 2. Save startLBA,numBlks		SM 1 Update byte counts	SM 1 Update byte counts		SM 1. Build response code
LM 1. From HLUN, look for VLUN 1. Find affected PLUN slice and insert the pHandle into frame header. 2. Insert target blade into FCBpage 3. Insert target E-DS or target DMU 4. Updates startLBA, numBlks SM 1. Build CDB in datapool	LM 1 Depending on pHandle MCAST bit, look up the PLUN OR look up pDevpath 2 Look up pDevpath if not yet resolved 3 Look up OWN FCPORT table 4 Update return registers for FCP to indicate target D_ID and source S_ID				
FCP 1. Send command frame downstream	FCP 1. Update the FC header 2 Send command frame out to wire	FCP 1 Ship data upstream	FCP 1 Ship data out to wire		FCP 1. Ship to server status 2 Deallocate IoCB

FIG. 10



UPSTREAM INGRESS COMMAND (1)	DOWNSTREAM EGRESS COMMAND (2)	DOWNSTREAM XFER RDY(3)	UPSTREAM INGRESS DATA(4)	DOWNSTREAM EGRESS DATA(5)	DOWNSTREAM INGRESS STATUS (5)	UPSTREAM EGRESS STATUS(6)
FCP 1. Allocate IoCB 2. Copy IoCB header to scratch1 3. Extract ownId,peerId into IoCB	FCP 1 Allocate IoCB 2 Save srcBlade from FCB	FCP 1 Look up IoCB 2. Send XFER_RDY upstream with command handle	FCP 1 Look up IoCB	FCP 1 Look up IoCB	FCP 1 Look up IoCB 2. Ship to upstream status 3. Deallocate IoCB	FCP 1 Look up IoCB
SM 1. Look for hLun(SID,FCLUN,port) 2. Save startLBA,numBlks			SM 1 Update byte counts	SM 1 Update byte counts		SM 1 Build response code
LM 1. Get pLun and insert the pHandle into frame header. 2. Insert target blade into FCBpage 3. Updates startLBA, numBlks	LM 1 Look up the pLun and pick a path 2 Save pLun and path index into IoCB					
SM 1. Build CDB in datapool						
FCP 1. Send command frame downstream	FCP 1 Send command frame out to wire		FCP 1 Ship data downstream	FCP 1 Ship data out to wire		FCP 1 Ship to server status 2 Deallocate IoCB

FIG. 11

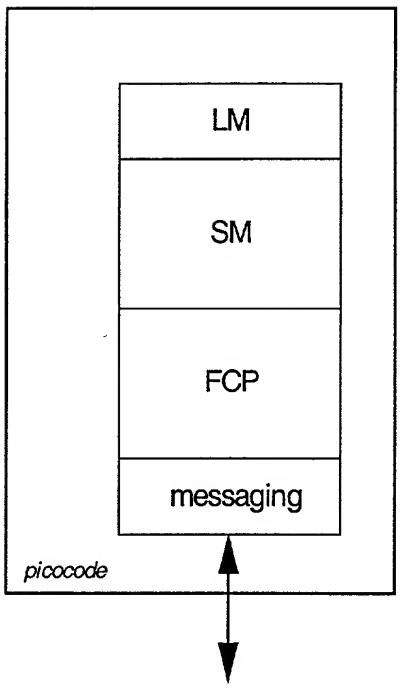


FIG. 12

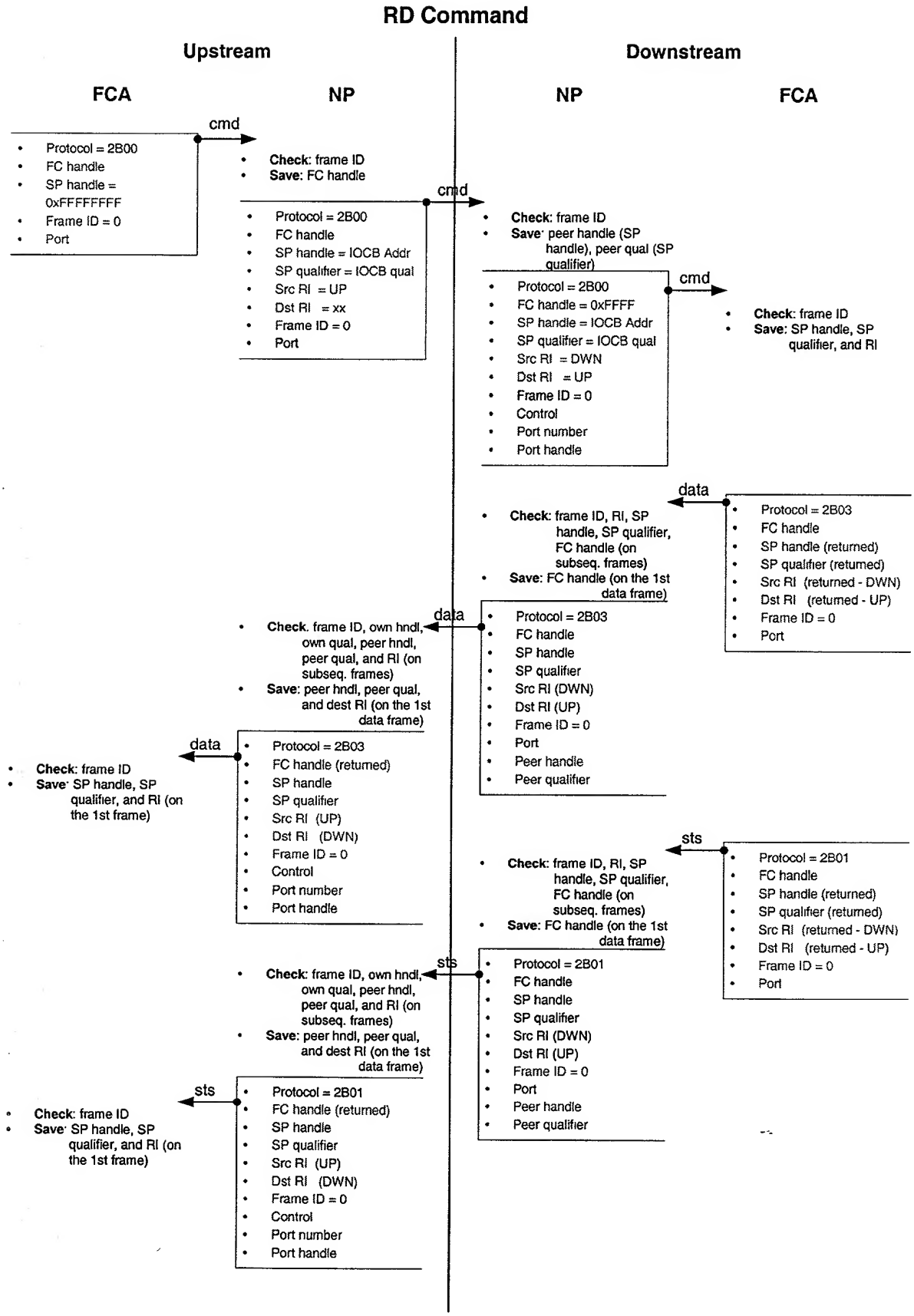

RD Command
Upstream
Downstream
FCA
NP
NP
FCA
cmd
Protocol = 2B00
FC handle
SP handle = 0xFFFFFFFF
Frame ID = 0
Port
Check: frame ID
Save: FC handle
cmd
Protocol = 2B00
FC handle
SP handle = IOCB Addr
SP qualifier = IOCB qual
Src RI = UP
Dst RI = xx
Frame ID = 0
Port
Check: frame ID
Save: peer handle (SP handle), peer qual (SP qualifier)
cmd
Protocol = 2B00
FC handle = 0xFFFF
SP handle = IOCB Addr
SP qualifier = IOCB qual
Src RI = DWN
Dst RI = UP
Frame ID = 0
Control
Port number
Port handle
Check: frame ID
Save: SP handle, SP qualifier, and RI
data
Protocol = 2B03
FC handle
SP handle (returned)
SP qualifier (returned)
Src RI (returned - DWN)
Dst RI (returned - UP)
Frame ID = 0
Port
Check: frame ID, RI, SP handle, SP qualifier, FC handle (on subseq. frames)
Save: FC handle (on the 1st data frame)
data
Protocol = 2B03
FC handle
SP handle
SP qualifier
Src RI (DWN)
Dst RI (UP)
Frame ID = 0
Port
Peer handle
Peer qualifier
Check. frame ID, own hndl, own qual, peer hndl, peer qual, and RI (on subseq. frames)
Save: peer hndl, peer qual, and dest RI (on the 1st data frame)
data
Protocol = 2B03
FC handle (returned)
SP handle
SP qualifier
Src RI (UP)
Dst RI (DWN)
Frame ID = 0
Control
Port number
Port handle
Check: frame ID
Save: SP handle, SP qualifier, and RI (on the 1st frame)
sts
Protocol = 2B01
FC handle
SP handle (returned)
SP qualifier (returned)
Src RI (returned - DWN)
Dst RI (returned - UP)
Frame ID = 0
Port
Check: frame ID, RI, SP handle, SP qualifier, FC handle (on subseq. frames)
Save: FC handle (on the 1st data frame)
sts
Protocol = 2B01
FC handle
SP handle
SP qualifier
Src RI (DWN)
Dst RI (UP)
Frame ID = 0
Port
Peer handle
Peer qualifier
Check: frame ID, own hndl, own qual, peer hndl, peer qual, and RI (on subseq. frames)
Save: peer hndl, peer qual, and dest RI (on the 1st data frame)
sts
Protocol = 2B01
FC handle (returned)
SP handle
SP qualifier
Src RI (UP)
Dst RI (DWN)
Frame ID = 0
Control
Port number
Port handle
Check: frame ID
Save: SP handle, SP qualifier, and RI (on the 1st frame)

FIG. 13

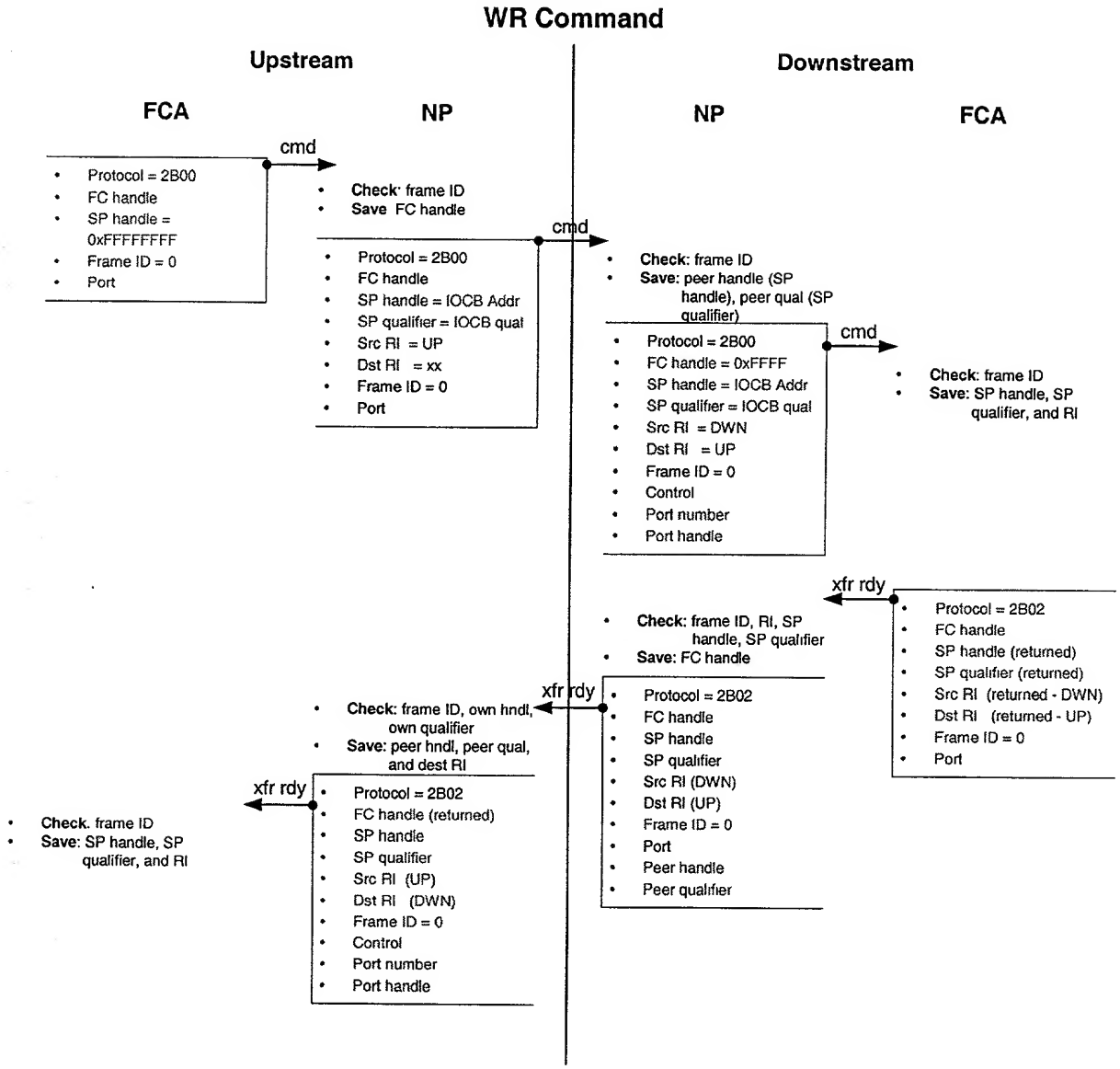

WR Command
Upstream
Downstream
FCA
NP
NP
FCA
cmd
Protocol = 2B00
FC handle
SP handle = 0xFFFFFFFF
Frame ID = 0
Port
Check: frame ID
Save: FC handle
cmd
Protocol = 2B00
FC handle
SP handle = IOCB Addr
SP qualifier = IOCB qual
Src RI = UP
Dst RI = xx
Frame ID = 0
Port
Check: frame ID
Save: peer handle (SP handle), peer qual (SP qualifier)
cmd
Protocol = 2B00
FC handle = 0xFFFF
SP handle = IOCB Addr
SP qualifier = IOCB qual
Src RI = DWN
Dst RI = UP
Frame ID = 0
Control
Port number
Port handle
Check: frame ID
Save: SP handle, SP qualifier, and RI
xfr rdy
Protocol = 2B02
FC handle
SP handle (returned)
SP qualifier (returned)
Src RI (returned - DWN)
Dst RI (returned - UP)
Frame ID = 0
Port
Check: frame ID, RI, SP handle, SP qualifier
Save: FC handle
xfr rdy
Protocol = 2B02
FC handle
SP handle
SP qualifier
Src RI (DWN)
Dst RI (UP)
Frame ID = 0
Port
Peer handle
Peer qualifier
Check: frame ID, own hndl, own qualifier
Save: peer hndl, peer qual, and dest RI
xfr rdy
Protocol = 2B02
FC handle (returned)
SP handle
SP qualifier
Src RI (UP)
Dst RI (DWN)
Frame ID = 0
Control
Port number
Port handle
Check: frame ID
Save: SP handle, SP qualifier, and RI

FIG. 14